

**Principal Investigator(s):** David S. Biedenharn CEERD-HR-R (601-634-4653) and Lawson Smith CEERD-GG (601-634-2497)

**Title:** Spatial and Temporal Sediment Transport Processes Within a Systems Context

**Topic Area:** Topic Area A2.1a Forensic Analysis of System Controls and Response

**Objective:** a. expand the knowledge of sediment transport processes in river systems, particularly with respect to the source and ultimate fate of sediments, b. apply this knowledge to produce a conceptual geomorphic model that will be used in the design phase for rehabilitation projects, and c. define the scaling relationships for transport processes as they apply to local and regional transport calculations.

**Problem:** One of the fundamental issues that engineers must address in channel rehabilitation projects, is the management of sediment. Design of stream and watershed rehabilitation projects without the understanding of the dynamics of the system often leads to failure of the implemented project, and may significantly decrease the quality of the affected ecosystem. Channel rehabilitation features such as grade control or bank stabilization are often implemented with the stated purpose of reducing sediment yields to downstream reservoirs, flood control channels, or wetlands. However, the spatial and temporal impacts of these features with respect to downstream sediment loads are far from straightforward. Recent findings from the Demonstration Erosion Control (DEC) Project and the Missouri River study of the impacts of bank stabilization on bar and island morphology have illustrated the importance of tracking sediments throughout the channel system. Once this process is understood, a more effective management scheme can be developed for the system.

**Benefits:** Understanding the intrinsic physical processes is the only rational basis for developing long term, sustainable solutions to sediment problems. Our proposed multi disciplinary research will decisively improve the ability of water resource engineers and scientists by providing a process-based framework to select effective alternatives for stream and watershed rehabilitation projects that satisfy engineering and ecological goals, and to significantly reduce life cycle costs. The benefits will serve federal, state, local, and private agencies involved in sediment management activities.

The proposed work will directly address field needs 12-B1 and B4, 28-A2, A3, and C7, 30-B2, B3, and D4, 41-C4, C5, and C7, 53-B1, and D1, 75-B1, and B2, and 77-B2 listed in the appendix. This research would also compliment on-going activities in the DEC Project, Missouri River Geomorphic Study being conducted by ERDC, and the existing work units in the Flood Damage Reduction Program

entitled “Design Guidance for Selecting and Siting Grade Control Structures,” and Regional Sediment Management in Flood Control Channels”. This work unit, when combined with companion work units on “Geomorphic Response of Regional Sediment Systems” and “Formation of Morphological Features of Sediment Systems” will provide the foundation for a proposed follow-on work unit entitled “Systems Approach to Regional Sediment Management,” which will develop guidance for the selection and design of the most appropriate rehabilitation measures to accomplish sediment management goals.

This work produces new tools and methods for the USACE and nation. It is an integral part of the Regional Sediment Management Research Program, and thus contributes primarily to support of the USACE’s navigation, flood/storm damage reduction, and environmental protection and quality missions. It supports all 8 Civil Works strategic goals and 7 of 9 Listening Session objectives identified by HQUSACE as R&D priorities. With companion work units, it employs active technology transfer and insertion.

### **Work Description:**

The scope of work proposed for this work unit will include the research tasks listed in the following outline.

1. Conduct international literature review and select series of channel systems throughout the U.S. for detailed data collection and analysis. Channels systems will be selected to characterize urban, agricultural, humid, semi-arid, and other watershed types in coordination with the work unit “Framework for Integrated Solutions.”.
2. Conduct detailed field investigations and data collection at selected channel systems. Particular emphasis will be placed on identifying major sediment sources and sinks in the systems and on the collection of bed and bank sediment samples.
3. Laboratory analyses of the collected samples will be conducted to determine the size fraction of bed and bank materials.
4. Conduct geomorphic assessment of channel systems to establish the overall morphologic character of the systems and any evolutionary trends.
5. Integrate the results of the analyses to produce a conceptual geomorphic model that correlates the impacts of sediment sources on the morphologic trends in the channel systems and how transport processes scale from local to regional.

6. The results of this study will be disseminated through TNs, journal papers, PROSPECT Courses, and workshops.

### **Products**

The primary products of this work will be improved knowledge of sediment transport processes at multiple scales and guidelines for scaling computations from meters and seconds up to km and years.

<u>Product</u>	<u>Scheduled</u>
1. TN: literature review and initial assessment of channel projects in U.S.	4Q/02
2. TN: field and preliminary geomorphic assessments of transport scaling	3Q/03
3. TR: Scaling Sediment Transport Processes	3Q/04
4. JP on Scaling Sediment Transport Processes	4Q/04